Claims

1. A method for controlling combustion of a reaction furnace comprising:

a furnace body having a furnace wall which surrounds a combustion chamber therein,

a plurality of reaction pipes provided between a pair of opposing wall portions of said furnace wall of said furnace body and juxtaposedly arranged therebetween so as to extend in the same direction,

a plurality of first burners arranged outside said reaction pipes and provided at said furnace wall of said furnace body for burning a fuel in said combustion chamber,

one or more second burners fixedly provided in at least one of paired fixing areas of said paired wall portions in which said reaction pipes are provided, so as to inject the fuel in an axial direction of said reaction pipes toward a space defined among two or more adjacent pipes of said reaction pipes, and

a heat exchange type combustion air supply apparatus for discharging exhaust gas from said combustion chamber to the outside of said reaction furnace through an air-permeable regenerating means and supplying to said combustion chamber combustion air elevated to a high temperature with sensible heat stored in said regenerating means;

wherein the method comprises steps of:

operating only said first burners to burn the fuel to elevate a temperature in said combustion chamber until the inside of said combustion chamber gets into a high temperature air combustion state,

operating said one or more second burners to burn the fuel after the high temperature air combustion state is attained in said combustion chamber, and

reducing a combustion amount of said first burners with an increase in combustion of said one or more second burners to thereby attain a necessary combustion state.

2. The method for controlling combustion of a reaction furnace as defined in Claim 1, wherein a ratio of the combustion amount of said first burners to the combustion amount of said one or more second burners is maintained at a level for said necessary combustion state after said necessary combustion state is attained.

3. The method for controlling combustion of a reaction furnace as defined in Claim 2, wherein the ratio of the combustion amount of said first burners to the combustion amount of said one or more second burners falls within a range of 80 : 20 to 0 : 100.

4. The method for controlling combustion of a reaction furnace as defined in Claim 1, wherein said necessary combustion state is attained in a manner that temperature distribution on a pipe wall in a circumferential direction of said reaction pipe does not become extremely ununiform in respect of each of said reaction pipes.

5. The method for controlling combustion of a reaction furnace as defined in Claim 4, wherein the ratio of the combustion amount of said first burners to the combustion amount of said one or

more second burners falls within a range of 50 : 50 to 0 : 100.

6. The method for controlling combustion of a reaction furnace as defined in Claim 5, wherein an amount of air to be supplied to said combustion chamber by said heat exchange type combustion air supply apparatus is so defined that an average of oxygen concentrations in said exhaust gas falls within a range of 3.5 to 6 %.

7. A method for controlling combustion of a reaction furnace comprising:

a furnace body having a furnace wall which surrounds a combustion chamber therein,

a plurality of reaction pipes provided between a pair of opposing wall portions of said furnace wall of said furnace body and juxtaposedly arranged therebetween so as to extend in the same direction,

a plurality of first burners arranged outside said reaction pipes and provided at said furnace wall of said furnace body for burning a fuel in said combustion chamber,

one or more second burners fixedly provided in at least one of paired fixing areas of said paired wall portions in which said reaction pipes are provided, so as to inject the fuel in an axial direction of said reaction pipes toward a space defined among two or more adjacent pipes of said reaction pipes, and

a heat exchange type combustion air supply apparatus for discharging exhaust gas from said combustion chamber to the outside of said reaction furnace through an air-permeable regenerating means and supplying to said combustion chamber

combustion air elevated to a high temperature with sensible heat stored in said regenerating means;

wherein the method comprises steps of:

primarily operating said first burners to burn the fuel to elevate a temperature in said combustion chamber until the inside of said combustion chamber gets into a high temperature air combustion state,

increasing a combustion amount of said one or more second burners after the high temperature air combustion state is attained in said combustion chamber, and

reducing a combustion amount of said first burners with an increase in combustion of said one or more second burners to thereby attain a necessary combustion state.

8. The method for controlling combustion of a reaction furnace as defined in Claim 7, wherein a ratio of the combustion amount of said first burners to the combustion amount of said one or more second burners is maintained at a level for said necessary combustion state after said necessary combustion state is attained.

9. The method for controlling combustion of a reaction furnace as defined in Claim 8, wherein the ratio of the combustion amount of said first burners to the combustion amount of said one or more second burners falls within a range of 80 : 20 to 0 : 100.

10. The method for controlling combustion of a reaction furnace as defined in Claim 7, wherein said necessary combustion state is attained in a manner that temperature distribution on a pipe

wall in a circumferential direction of said reaction pipe does not become extremely ununiform in respect of each of said reaction pipes.

11. The method for controlling combustion of a reaction furnace as defined in Claim 10, wherein the ratio of the combustion amount of said first burners to the combustion amount of said one or more second burners falls within a range of 50 : 50 to 0 : 100.

12. The method for controlling combustion of a reaction furnace as defined in Claim 11, wherein an amount of air to be supplied to said combustion chamber by said heat exchange type combustion air supply apparatus is so defined that an average of oxygen concentrations in said exhaust gas falls within a range of 3.5 to 6 %.

13. A reaction furnace comprising:

a furnace body having a furnace wall which surrounds a combustion chamber therein,

a plurality of reaction pipes provided between a pair of opposing wall portions of said furnace wall of said furnace body and juxtaposedly arranged therebetween so as to extend in the same direction,

a plurality of first burners arranged outside said reaction pipes and provided at said furnace wall of said furnace body for burning a fuel in said combustion chamber,

a plurality of partial combustion air supply apparatuses for said first burners arranged outside said reaction pipes and so constructed as to discharge exhaust gas from said combustion

chamber to the outside of said reaction furnace through one or more air-permeable regenerators and to supply to said first burners combustion air elevated to a high temperature with sensible heat stored in said one or more regenerators,

one or more second burners fixedly provided in at least one of paired fixing areas of said paired wall portions in which said reaction pipes are provided, so as to inject the fuel in an axial direction of said reaction pipes toward a space defined among two or more adjacent pipes of said reaction pipes, and

one or more partial combustion air supply apparatuses for said one or more second burners so constructed as to discharge exhaust gas from said combustion chamber to the outside of said reaction furnace through one or more air-permeable regenerators and to supply to said one or more second burners combustion air elevated to a high temperature with sensible heat stored in said one or more regenerators;

wherein a ratio of the combustion amount of said first burners to the combustion amount of said one or more second burners falls within a range of 50 : 50 to 0 : 100 when the inside of said combustion chamber is in a high temperature air combustion state.

14. The reaction furnace as defined in Claim 13, wherein an amount of air to be supplied to said combustion chamber by said partial combustion air supply apparatus for said first burner and/or that of air to be supplied to said combustion chamber by said partial combustion air supply apparatus for said second burner is so defined that an average of oxygen concentrations in said exhaust gas falls within a range of 3.5 to 6 %.

15. The reaction furnace as defined in Claim 13, wherein said first burners are fixedly provided at one of said paired wall portions and said second burners are fixedly provided on the other wall portion.

16. The reaction furnace as defined in Claim 15, wherein said second burner is so constructed as to form a partial combustion flame of which a maximum gas temperature becomes 500 ° C or more.

17. The reaction furnace as defined in Claim 13, wherein said first burner and said partial combustion air supply apparatus for said first burner are combined to constitute one regenerative burner of a high temperature air combustion type, and said second burner and said partial combustion air supply apparatus for said second burner are combined to constitute one regenerative burner of a high temperature air combustion type.

18. A reaction furnace comprising:

a furnace body having a furnace wall which surrounds a combustion chamber therein,

a plurality of first burners provided at said furnace wall of said furnace body for burning a fuel in said combustion chamber,

a plurality of partial combustion air supply apparatuses for said first burners so constructed as to discharge exhaust gas from said combustion chamber to the outside of said reaction furnace through one or more air-permeable regenerators and to supply to said first burners combustion air elevated to a high temperature with sensible heat stored in said one or more

regenerators,

a plurality of reaction pipes fixedly provided between a pair of opposing wall portions of said furnace wall so as to extend in the same direction,

one or more second burners fixedly provided in at least one of paired fixing areas of said paired wall portions onto which said reaction pipes are fixed, so as to inject the fuel in said extending direction of said reaction pipes toward a space defined among two or more adjacent pipes of said reaction pipes, and

one or more partial combustion air supply apparatuses for said one or more second burners for discharging exhaust gas from said combustion chamber to the outside of said reaction furnace through one or more air-permeable regenerators and supplying to said one or more second burners combustion air elevated to a high temperature with sensible heat stored in said regenerators;

wherein the plurality of said first burners are arranged outside said reaction pipes and fixedly provided at said furnace wall so as to inject the fuel in an extending direction of said reaction pipes or a direction crossing said extending direction of said reaction pipes; and

wherein a positional relationship of said first burners with said one or more second burners and a combustion ratio of said first burners to said one or more second burners are defined in a manner that efficiency in thermal conduction of said reaction pipes becomes more than one, supposing that an amount of heat received by said reaction pipes is one when said reaction pipes are heated only with said first burners.

19. The reaction furnace as defined in Claim 18, wherein said first burners are fixedly provided at one of said paired wall portions and said one or more second burners are fixedly provided at the other wall portion, and said first burners are dispersedly arranged so that said reaction pipes exist therebetween.

20. The reaction furnace as defined in Claim 18, wherein said one or more second burners are fixed onto either of said paired wall portions, and said first burners are dispersedly arranged at a pair of opposing wall portions other than said paired wall portions so that said reaction pipes exist therebetween.

21. The reaction furnace as defined in Claim 18, wherein a combustion ratio of said first burners to said one or more second burners is 80 : 20.

22. The reaction furnace as defined in Claim 18, wherein said one or more partial combustion air supply apparatuses for said one or more second burner are so arranged as to supply said combustion air to said one or more second burners from the outside of said reaction pipes, and an amount of the air to be supplied by said partial combustion air supply apparatus for said second burner is less than 30% of a theoretical fuel air amount against an amount of the fuel to be supplied by said second burner.

23. The reaction furnace as defined in Claim 22, wherein said reaction pipes are so arranged that a distance between any two adjacent pipes of said reaction pipes is equal, and said second

burners are so arranged that a distance between any adjacent second burner and reaction pipe is equal.

24. The reaction furnace as defined in Claim 18, wherein said first burner and said partial combustion air supply apparatus for said first burner are combined to constitute one regenerative burner of a high temperature air combustion type, and said second burner and said partial combustion air supply apparatus for said second burner are combined to constitute one regenerative burner of a high temperature air combustion type.